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Collaborative Research: From Loading to Dynamic Rupture - How do Fault Geometry and Material Heterogeneity Affect the Earthquake Cycle?

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This proposal lays the groundwork for the PIs' long-term goals of modeling and understanding the full earthquake cycle in realistic and complex fault systems. The work enables the self-consistent exploration of the impact of bimaterial faults, plasticity, and large-scale fault geometry on the earthquake cycle. Results will be compared with field observations. The work will advance numerical methods through the development of an adaptive discontinuous Galerkin finite element method for earthquake cycle simulations with the inclusion of plasticity. The developed modeling tool will allow for the future exploration of small-scale fault roughness, realistic subduction zone geometries, and complex fault networks. The numerical models developed will also have implications for other geophysical problems such glacier and landslide dynamics.

This proposed work benefits the society at large as understanding the impact of complexity on the earthquake cycle directly informs our understanding of seismic hazard. Both PIs are early career faculty in mathematics departments and this work supports their involvement in geophysics research where new computational tools are needed. The PIs' codes will be open source and published on the GitHub repository website. Both PIs will co-mentor a PhD student under this proposal (hosted at Portland State University) as well as recruit under-represented undergraduate students for research projects related to this proposal. Both PIs will share results with the general public through the Geological Society of the Oregon Country (www.gsoc.org) Friday lecture series at Portland State University.

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